

Strategic Decision for Logistics Sustainability in Steel Production in India: “An analysis within the Indian Steel sector”.

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Abstract—The purpose of this paper is to understand the role of both internal and external factors and the logistics barriers influencing for higher cost for the Indian steel manufacturing companies. Steel industry is the primary industry which plays very important role in the development of a country and its economic sustainability. The world is fast changing with a rebalancing of manufacturing across the developed and developing economics. China, with its rising wages and swelling cost of production, is losing its cost advantage. India is starting from a position that is advantageous in the competitive global environment.

India has some major problems like, the logistics barriers such as lack of an enabling infrastructure, port inefficiency for handling international cargo and lack of demonstrated capability to compete at the global scale because of the current logistics managements and practices followed in India. The international logistics barriers in steel industry are considered as one of the biggest hurdle and damaging the performance of the entrepreneur in this research.

Interpretative Structural Modelling approach is used to develop the model based on the structural relationship of the logistics 15 barriers. The model clearly highlighted that “Lack of commitment by the top management” rests at the second bottom of the hierarchy and most important among all factors. This further validated the results so obtained using multi-criteria approach.

Many steel industries in India have focused on identifying barriers on their logistics practices and management, but a model for the barriers of logistics management practices are lacking. Finally, it is suggested that the role of managers in understanding and describing the importance of logistics management operation and the strategic planning to overcome with the unexpected situation in the achievement of sustained competitive advantage.

Today, the global business environment is influenced by financial instability, just in time, outsourcing, company mergers, new technologies, e-business, shorter time to market etc, thus forcing organizations to adopt new ways of doing business. In such an environment, logistics management in steel industries are becoming challenging and important, primarily because of uncertainties in supply and demand. Logistic management has been treated as one of the most potential area for the companies to provide a base for cost reduction and service improvements. Majorly, in India the steel industries set up their plants closer to the mining area (in order to minimize the high cost of inbound transportation), but with the advent of time, this advantage confined only for industries manufacturing mild steel or low carbon steel (which primarily is manufactured from iron ore).

The organizations manufacturing steels or special steels (with specific composition of Ni, Cr, Si and Mo) have realized that in order to compete on cost, they need to manufacture steel using the scrap steels and not from iron ore. Majorly the scrap steel is imported and it comes to ports, managing entire inbound logistics from port to plant is not only affecting their competitiveness but also disturbing the manufacturing planning owing to non-timely availability of material. Typically, in Indian steel sector, the total cost of inbound and outbound costs taken together range around 15-16% of the turnover whereas, the world average is around 7-8%.

INTRODUCTION

India’s steel sector needs innovative technological support and solutions for the continuity on their production plan so that they can meet the requirement market demand suitably in time.

Today, the global business environment is influenced by financial instability, just in time, outsourcing, company mergers, new technologies, e-business, shorter time to market etc, thus forcing organizations to adopt new ways of doing business. In such an environment, logistics management in steel industries are becoming challenging and important, primarily because of uncertainties in supply and demand. Further, Free Trade Policies, WTO arrangements, the liberalized business environment have made non-existent business boundaries and are forcing organizations for greater attention towards un-interruption in production and their sustainability and survival. Both the government and industries have realized the importance of the subjects and have started examining ways to address this issue (Chopra and Sodhi, 2004)

At the current scenario, raw material sourcing and logistics management are very critical in the complete growth of steel industry in the country. Requirement of major raw material in the steel industry is determined not only by the rate of growth in output but also by the type of technology adopted for making the steel. Iron ore is the primary raw material in the steel industry and have a lion share of over fifty percent of the total raw material requirement in the industry. Therefore, the

steel plants in India are primarily located near by the iron ore sources so as to reduce the transportation logistics cost and ensure reliability of supply from mines to plant. Also, all steel plants in India have obtained their iron ore captive mines for their raw material security.

Logistics process and management in Indian Steel Industry are undergoing radical transformations due to the mega-competition taking place on a global scale. Manufacturing success and survival are becoming more and more difficult in today's market. The emphasis is an adaptability to change in the business environment and on addressing market suitability and to meet the customer needs proactively. It is beneficial for the management of any firm to be aware of significant barriers and to diagnose those that could be integral to the organization's future survival.

LITERATURE REVIEW

Christopher (1992) defines logistics management as the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet the customers' requirements. Vinay *et al.* (2007) recognize the tremendous potential of logistics and its major strategic role in companies with increased global competition to gain a competitive advantage. Because of this intense competition among companies, logistics outsourcing has been rapidly expanding so as to achieve competitive advantage and cost savings (Rabinovich *et al.*, 1999).

BARRIERS ON INTERNATIONAL LOGISTICS MANAGEMENT AND OPERATION PRACTICES

Despite the fact that practices related to inbound and outbound logistics have helped the cause of environment protection, practicing the much-needed approaches is not free from barriers. In this paper, 15 variables for barriers to the inbound and outbound logistics have been selected from the literature primarily from Ref (S. Jharkharia, 2005) and also from discussions with experts in the Indian steel industry, keeping the Indian steel manufacturing industry in focus (Table 1). These barriers are explained as follows.

1) *Lack of appropriate performance matrices*

Appropriate performance matrices are the important monitoring mechanism on the inbound and outbound logistics process in any of the manufacturing industry. Lack of performance metrics is a major barrier to the inbound and outbound logistics programs in Indian steel sector.

2) *Lack of sufficient warehouses beyond major cities*

Warehouse plays a significant role in the context of storage of raw material for steel industries and to distribute it as per the requirement of plant for production. There are mainly three

types of warehouses available in India for the storage of bulk materials.

- a) Private warehouses.
- b) Public warehouses owned by state and central government.
- c) Bonded warehouses

In Indian context, it is noticed that there are not sufficient warehouses beyond major cities resulting the material movement from port to plant are getting disturbed and inventory cost increases.

3) *Lack of road and rail connectivity*

In India, it is noticed that road condition is very poor and rail connectivity to port area are not there resulting both inbound and outbound cargo are shifted to railway siding first and then it is getting loaded to wagons for the further movements. These multiple handlings are not increasing the logistics cost but also increasing material handling loss. Lack of road and rail connectivity to port areas leads to:

- a) Material handling loss
- b) In transit theft and pilferages
- c) Material safety at port area
- d) Weighbridge tolerance because of multiple handling places

4) *Complicated tax structure*

The tax structure in India is not uniform at all places or states within the country. The tax structure is very much complicated within the states also. There are mainly four major taxes applicable for cross boarder of states.

- a) Central government taxes applicable for states.
- b) State Government taxes applicable for the respective states only
- c) Local taxes applicable on few states in India
- d) Cross broader taxes applicable on few states in India

5) *Lack of Infrastructure issues*

Infrastructure plays equally important role for the smooth and hassle free operation on logistics functions of a firm. Good infrastructure at steel plants like paved and concrete area, in plant warehouses and in-house handling equipments helps in delivering the material in time to plant for productions at a optimum logistics cost. Finished delivery and in plant logistics also becomes easier. On cost point of view, good infrastructure helps in,

- a) Material handling at Port at a shortest time and avoid any penalty.
- b) Finished products handling at warehouses

- c) Warehouse management with optimum logistics cost

6) Lack of technological support

The role of technical support is very much important for material tracing and tracking and global position of the materials imported or exported so that precautionary measures can be taken well in advance to meet the requirement of plant or finished products for the ultimate customers. Therefore, information technology and support has been considered as one of important tool for improving the efficiency of the logistics value chain particularly for the steel manufacturing companies where material inflow and outflow are quite huge on day to day basis. Technological supports such as:

- a) EDI system
- b) Internet
- c) Intranet
- d) GPS
- e) ERP
- f) Extranet and etc.

7) Lack of long-term relationships

Long term relationships with both internal and external agencies are very much required where inbound and outbound movements are quite huge so that any point of time, the material movement should not get disturbed. Long terms relationship can be defined as:

- a) Internal relationship
- b) External relationship

Internal relationship is nothing but an interface with the finance and legal team within the organization to streamline the inbound and outbound processes.

External relationship includes the co-operation between the management and external agencies like shipping company, end to end logistics providers, port authorities, railway departments and etc.

8) Socio-political issues

Socio Political issues are one of tedious hindrances on the entire supply chain management system in India. India is a vast country with different categories of people, cast, creed and with multiple cultural activities which differs from state to state. Many ports in India are badly affected because of trade unions and local union issues. Port strike is also quite phenomenal at the eastern ports in India.

9) Financial constraints

Finance is essential to support the infrastructure and manpower requirements of the inbound and outbound logistics of a company. Companies require allocation of funds and other resources for the implementation of inbound and

outbound logistics process and its management in a seamless manner.

10) Rigid company policies

Companies want to create a brand image to the customers and at the same time company needs to spend the resources for quality checked material to be used for the productions so that at a later stage the products should not get rejected by the overseas buyer and the goodwill of the firm should not get damaged.

11) Problem with the service quality

Service quality is an important barrier affecting the inbound and outbound logistics in Indian steel sector. All steel manufacturing industries in India are fully dependent on the imported raw materials from different overseas markets. The voyage transit time varies from destination to destination also. There may be chances of multiple transshipments with multiple handling when the material is on the waterway.

12) Lack of strategic planning

The logistics functions for Indian steel industry are very much in demanding stage because of on time delivery and lean inventory. At the same time, both the economy and e-commerce are also on demanding that companies may adopt end to end logistics as their strategic planning arsenal. Composite contracts and in-house logistics for both incoming and outgoing materials can be used as a strategic weapon in the present industrial environment particularly for the steel manufacturing industries in India where both incoming and outgoing volumes are substantially high.

13) Geographic spread and access to customers

The steel manufacturing companies in India are mainly located where the minerals are available. The finished products need to be delivered at different locations of the globe. With these wide range of geographical spread and different range of products by the steel manufacturing products in India, it has become very difficult to deliver the material at customer's site within the stipulated time. Many steel companies in India have started adopting the warehouse model as distribution centre for delivering their finished product at cheaper cost with lesser transit time.

14) Lack of commitment by top management

Lack of commitment by the senior management is a barrier for the successful inbound and outbound logistics function for the steel manufacturing company in India. A major challenge seen in logistics operations is the lack of commitment by top management (Fawcett, 2001). Efficient leadership is needed to provide clear vision and value to the logistics processes and programs.

15) Lack of awareness about inbound and outbound logistics process

The primary and foremost barrier of inbound and outbound logistics processes seen in Indian steel manufacturing companies are lack of awareness about the benefits of inbound and outbound logistics process and its management.

In Indian context, people engaged in the logistics functions in steel industries are needed to be geared up to understand the latest version of international commercial terms and to have adequate shipping knowledge for better negotiations on transportation prices.

ISM methodology and model development

The methodology of ISM is an interactive learning process. In this process, a set of different and directly related variables affecting the system under considerations are structured into a comprehensive systemic model. The beauty of the ISM model is that it portrays the structure of a complex issue of the problem under study, in a carefully designed pattern employing graphics as well as words. The methodology of ISM can act as a tool for imposing order and direction on the complexity of relationships among elements of a system (Sage, 1977).

The aim of this research is to identify interactions of the barriers in implementing a perfect inbound and outbound logistics process by a manufacturing company. This work differs from the previous work done by Barve *et al.* (2007) in terms of the barriers identification in the study for our case company and its implementation environment. The various steps involved in the ISM methodology are given below (Kannan and Haq, 2006):

ISM is primarily intended as a group learning process, but it can also be used individually. The various steps involved in the ISM methodology are:

- Step 1:* Variables affecting the system under consideration are listed, which can be objectives, actions, and individuals etc.
- Step 2:* From the variables identified in step 1, a contextual relationship is established among variables with respect to which pairs of variables would be examined.
- Step 3:* A structural self-interaction matrix (SSIM) is developed for variables, which indicates pair wise relationships among variables of the system under consideration.
- Step 4:* Reachability matrix is developed from the SSIM and the matrix are checked for transitivity. It states that if a variable A is related to B and B is related to C, then A is necessarily related to C.
- Step 5:* The Reachability matrix obtained in Step 4 is partitioned into different levels.

Step 6: Based on the relationships given above in the reachability matrix, a directed graph is drawn and the transitive links are removed.

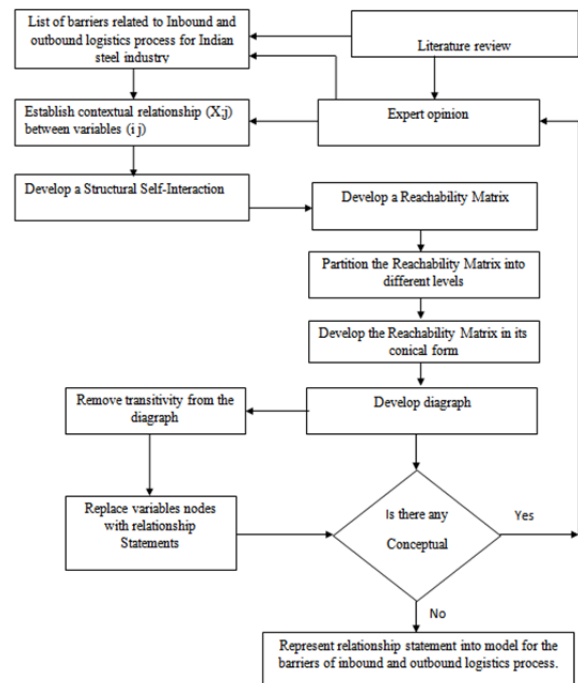
Step 7: The resultant digraph is converted into an ISM, by replacing variable nodes with statements.

Step 8: The ISM model developed in Step 7 is reviewed to check for conceptual inconsistency and necessary modifications are made.

The literature review, along with the expert’s opinion was used in developing the relationship matrix, which is later used in the development of an ISM model.

Structural self-interaction matrix (SSIM)

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal technique, etc., in developing the contextual relationship among the variables. Thus, in this research for identifying the contextual relationship among the barriers for the inbound and outbound logistics process for Indian steel industry. In this research, 15 experts, ten from the industry and five from academia were consulted in identifying the nature of contextual relationship among the variables. These experts from the industry and academia were well conversant with the inbound and outbound logistics process and practices in the industry having an experience of over 16 years in this area.



(Source: Modified from Rani and Dharker, 1996)

Figure 1: Flow diagram for ISM adopted in present research

In order to analyze the relationship among the inbound and outbound logistics variables, a conceptual relationship of “lead to” type is chosen. Keeping in mind the contextual relationship for each variable, the existence of a relationship for each variable, the existence of a relation between any two variables (*i* and *j*) and the associated direction of the relation are questioned. Four symbols are used to denote the direction of relationship between the variables (*i* and *j*).

Keeping in mind the contextual relationship for each variable, the existence of a relation between any two barriers (*i* and *j*) and the associated direction of the relation is questioned. Four symbols are used to denote the direction of relationship between the barriers (*i* and *j*):

V: Barrier *i* will help alleviate Barrier *j*;

A: Barrier *j* will be alleviated by Barrier *i*;

X: Barriers *i* and *j* will help achieve each other; and

O: Barriers *i* and *j* are unrelated.

The following would explain the use of the symbols V, A, X, and O in SSIM (Table 1).

- (i) Barrier 8 helps alleviate Barrier 10. This means that as efforts are made to plug the gap in the top management commitment for supporting logistics practices, effectiveness of strategic planning improves. Thus, the relationship between Barriers 8 and 10 is denoted by 'V' in the SSIM (Table 1).
- (ii) Barrier 8 can be alleviated by Barrier 9, i.e. removal of Barrier 9, namely, lack of awareness about inbound and outbound logistics process would help alleviate Barrier 8 (i.e. lack of commitment by top management). Awareness about the inbound and outbound logistics process would promote the top management commitment for implementing various logistics programs. Thus, the relationship between these barriers is denoted by “A” in the SSIM (Table 1).
- (iii) Barriers 4 and 6 help achieve each other. Barrier 4, namely, resistance to change for activities related to reverse logistics and Barrier 6, namely, black of training related to the logistics process help achieve each other. Thus, the relationship between these barriers is denoted by “Barriers” in the SSIM (Table 1).
- (iv) No relationship exists between lack of appropriate performance metrics (Barrier 5) and financial constraints (Barrier 7) and hence the relationship between these barriers is denoted by “O” in the SSIM (Table 1)

Reachability matrix

The SSIM is transformed into a binary matrix, called the initial reachability matrix by substituting V, A, X, O by 1 and 0 as per the case. The rules for the substitution of 1's and 0's are the following. Table: 1, Presents SSIM for logistics barriers.

Table 1: Final results on ISM iterations on logistics barriers

Barrier	Reachability Set	Antecedent set Intersect	Intersect on Set	Level
1	1,2,4,5,8,9,10,11	1,6	1	IX
2	2,3,4,8,10,12,13	1,2,5,6	2	III
3	3	2,3,4,5,7,8,9,11,13	3	I
4	3,4,8,9,10	1,2,4,9,12,14,15	4,9	V
5	2,3,5,8,9,10,11	1,5,6	5	VII
6	1,2,5,6,10,13,14,15	1	6	X
7	3,7	7,10,11,13,14	7	II
8	3,11,8	1,2,4,5,8,9,12,15	8	IV
9	3,4,8,9,13	1,4,5,9,15	9,4	V
10	7,10,11,13	1,2,4,5,6,10,11,13,14	10,11,13	III
11	3,7,10,11,13	4	10,11,13	III
12	4,12,14,15,8,13	1,5,8,10,11,13,14,15	12,14,15	VI
13	3,7,10,11,13	2,12,14,15	10,11,13	III
14	4,12,14,15,10,11,7	2,6,9,10,11,12,13,15	12,14,15	VI
15	4,9,12,14,15,8,11,13	6,12,14,15	12,14,15	VI

Based on these rules reachability matrix is prepared and it is presented in Table 2

- 1. If the (*i,j*) entry in the SSIM is V, then the (*i,j*) entry in the reachability matrix becomes 1 and the (*j, i*) entry becomes 0.
- 2. If the (*i,j*) entry in the SSIM is A, then the (*i,j*) entry in the reachability matrix becomes 0 and the (*j, i*) entry becomes 1.
- 3. If the (*i, j*) entry in the SSIM is X, then the (*i,j*) entry in the reachability matrix becomes 1 and the (*j, i*) entry also becomes 1.
- 4. If the (*i, j*) entry in the SSIM is O, then the (*i,j*) entry in the reachability matrix becomes 0 and the (*j, i*) entry also becomes 0.

Table 2: Reachability matrix on logistics cost barriers

Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driver Power
1. Lack of appropriate Logistics Performance Matrixes	1	1	0	1	1	0	0	1	1	1	1	0	0	0	0	8
2. Lack of Sufficient Warehouses beyond major cities	0	1	1	1	0	0	0	1	0	1	0	1	1	0	0	7
3. Road and Rail connectivity	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4. Complicated Tax structure	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	5
5. Poor Infrastructure issues	0	1	1	0	1	0	0	1	1	1	1	1	0	0	0	8
6. Lack of information technology	1	1	1	0	1	1	0	0	0	1	0	0	1	1	1	9
7. Long term relationship	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2
8. Socio-Political issues	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	3
9. Financial constraints	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	5
10. Company Policies	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	4
11. Problem with product life quality	0	0	1	0	0	0	1	0	0	1	1	0	1	0	0	5
12. Lack of Strategic Planning	0	0	0	1	0	0	0	1	0	0	0	1	1	1	1	6
13. Geographic Spread and access to customers	0	0	1	0	0	0	1	0	0	1	1	0	1	0	0	5
14. Lack of commitment by Top Management	0	0	0	1	0	0	1	0	0	1	1	1	0	1	1	7
15. Lack of awareness about inbound and outbound logistics Process.	0	0	0	1	0	0	0	1	1	0	1	1	1	1	1	8

Dependence	2	4	1	7	3	1	5	8	5	9	8	5	8	4	4
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Table 3: Iteration 1

Barrier	Reachability Set	Antecedent set Intersect	Intersection set	Level
1	1,2,4,5,8,9,10,11	1,6	1	
2	2,3,4,8,10,12,13	1,2,5,6	2	
3	3	2,3,4,5,7,8,9,11,13	3	
4	3,4,8,9,10	1,2,4,9,12,14,15	4,9	I
5	2,3,5,8,9,10,11	1,5,6	5	
6	1,2,5,6,10,13,14,15	1	6	
7	3,7	7,10,11,13,14	7	
8	3,11,8	1,2,4,5,8,9,12,15	8	
9	3,4,8,9,13	1,4,5,9,15	9,4	
10	7,10,11,13	1,2,4,5,6,10,11,13,14	10,11,13	
11	3,7,10,11,13	1,5,8,10,11,13,14,15	10,11,13	
12	4,12,14,15,8,13	2,12,14,15	12,14,15	
13	3,7,10,11,13	2,6,9,10,11,12,13,15	10,11,13	
14	4,12,14,15,10,11,7	6,12,14,15	12,14,15	
15	4,9,12,14,15,8,11,13	6,12,14,15	12,14,15	

The final reachability matrix is obtained by incorporating the transitivity as enumerated in Step 4 of the ISM methodology. This is shown in Table 2. In this table, the driving power and dependence of each barrier are also shown.

Level partitions

The reachability and antecedent set (Warfield, 1974) for each barrier is found out from final reachability matrix. The reachability set for a particular variable consists of the variable itself and the other variables, which it may help achieve. The antecedent set consists of the variable itself and the other variables, which may help in achieving them. Subsequently, the intersection of these sets is derived for all variables as follows:

Table 4: Iteration 2 for logistics barriers

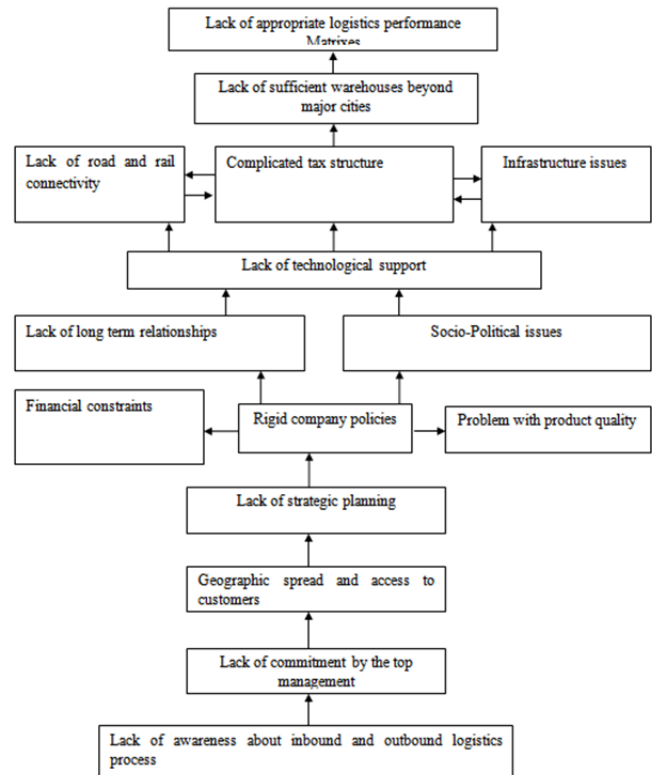
Barrier	Reachability Set	Antecedent set Intersect	Intersection Set	Level
1	1,2,4,5,8,9,10,11	1,6	1	
2	2,3,4,8,10,12,13	1,2,5,6	2	
3	3	2,3,4,5,7,8,9,11,13	3	
4	3,4,8,9,10	1,2,4,9,12,14,15	4,9	
5	2,3,5,8,9,10,11	1,5,6	5	
6	1,2,5,6,10,13,14,15	1	6	
7	3,7	7,10,11,13,14	7	II
8	3,11,8	1,2,4,5,8,9,12,15	8	
9	3,4,8,9,13	1,4,5,9,15	9,4	
10	7,10,11,13	1,2,4,5,6,10,11,13,14	10,11,13	
11	3,7,10,11,13	1,5,8,10,11,13,14,15	10,11,13	

12	4,12,14,15,8,13	2,12,14,15	12,14,15	
13	3,7,10,11,13	2,6,9,10,11,12,13,15	10,11,13	
14	4,12,14,15,10,11, 7	6,12,14,15	12,14,15	
15	4,9,12,14,15,8,11, ,13	6,12,14,15	12,14,15	

Table 5: Final results on ISM iterations on logistics barriers

Barrier	Reachability Set	Antecedent set Intersect	Intersection Set	Level
1	1,2,4,5,8,9,10,11	1,6	1	IX
2	2,3,4,8,10,12,13	1,2,5,6	2	III
3	3	2,3,4,5,7,8,9,11,13	3	I
4	3,4,8,9,10	1,2,4,9,12,14,15	4,9	V
5	2,3,5,8,9,10,11	1,5,6	5	VII
6	1,2,5,6,10,13,14, 15	1	6	X
7	3,7	7,10,11,13,14	7	II
8	3,11,8	1,2,4,5,8,9,12,15	8	IV
9	3,4,8,9,13	1,4,5,9,15	9,4	V
10	7,10,11,13	1,2,4,5,6,10,11,13,14	10,11,13	III
11	3,7,10,11,13	1,5,8,10,11,13,14,15	10,11,13	III
12	4,12,14,15,8,13	2,12,14,15	12,14,15	VI
13	3,7,10,11,13	2,6,9,10,11,12,13,15	10,11,13	III
14	4,12,14,15,10,11, 7	6,12,14,15	12,14,15	VI
15	4,9,12,14,15,8,11, ,13	6,12,14,15	12,14,15	VI

Variables. From Table 5, it is seen that lack of performance metrics (Barrier 1) is found at level I. Thus, it would be positioned at the top of the ISM model. This iteration is continued till the levels of each variable are found out. The identified levels aids in building the digraph and the final model of ISM. The barriers, along with their reachability set, antecedent set, intersection set and the levels..



Suggestions

The barriers hindering the inbound and outbound logistics processes pose considerable challenges both for managers and policymakers in industries. Some of the major barriers have been highlighted here and put into an ISM model, to analyze the interaction between the barriers. These barriers need to be overcome for the success in inbound and outbound logistics management in Indian Steel Industry. The driver-dependence diagram gives some valuable insights about the relative importance and the interdependencies among the barriers. This can give better insights to the top management so that they can proactively deal with these barriers. From the ISM model, it is observed that strategic management issues like lack of awareness of logistics management and lack of commitment by top management are at the bottom level of the hierarchy implying higher driving power.

Therefore, top management should focus on developing strategies to create awareness about the process of inbound and outbound logistics management so that the benefits of it can be reaped. It is also observed that lack of performance metrics, road and rail connectivity, lack of information and technological systems, infrastructure issues are the focus areas on inbound and outbound logistics practices, socio –political issues, and unconcerned company policies are weak drivers but strongly dependent on other barriers such as lack of awareness, lack of commitment, lack of strategic planning, quality problems, and financial constraints. The management should place a high priority in tackling the barriers, which have a high driving power and thus possessing the capability to influence other barriers.

Thus, the ISM-based model proposed the identification of barriers for inbound and outbound logistics processes can provide the decision maker a more realistic representation of the problem in the course of conducting and monitoring the logistics management.